Energy Boot Camp for Builders

Building Science and Changes to the Montana Energy Code

INTRODUCTION

December 2013
Presented by Dale Horton, Architect
National Center for Appropriate Technology
“...shall regulate the design and construction of buildings for the effective use and conservation of energy over the life of each building.”

Source: USDOE Building Energy Codes University
### MTDEQ and USDOE 2012 IECC Economics

Savings and cost of implementing the 2012 IECC vs the existing Montana State Energy Code.

<table>
<thead>
<tr>
<th></th>
<th>USDOE</th>
<th>MT DEQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor Area (SF)</td>
<td>2400</td>
<td>Weighted</td>
</tr>
<tr>
<td>Weighted Annual Savings</td>
<td>$310</td>
<td>$233</td>
</tr>
<tr>
<td>Life Cycle Cost Savings</td>
<td>$4,105</td>
<td>$4,043</td>
</tr>
<tr>
<td>Implementation Cost Estimate</td>
<td>$2,558</td>
<td>$3,175</td>
</tr>
<tr>
<td>Simple Payback</td>
<td>7.3</td>
<td>12.8</td>
</tr>
<tr>
<td>Annual Mortgage Increase</td>
<td>$130</td>
<td></td>
</tr>
<tr>
<td>Net Annual Cash Flow Savings</td>
<td>$180</td>
<td></td>
</tr>
</tbody>
</table>
Training Objectives

1. Montana Energy Code Changes
2. Building Science Shapes the Energy Code
3. Software tools (REScheck and REM/Rate)
4. Building and Duct Tightness Testing
5. Other

What this training will not provide a comprehensive energy code training.
Section 1: Introduction

This course is about the Energy Code and Building Science

More than that, it is about building better houses:

- Comfort
- Durability
- Occupant Health
- Energy Savings
- Affordability
External Human Comfort Factors

Internal Comfort Factors
1. Metabolic Rate
2. Clothing Insulation

Occupants

Mean Radiant Temperature
Air Temperature
Relative Humidity
Air Movement
Internal Comfort Factors
1. Metabolic Rate
2. Clothing Insulation
“Good Government” As A System

Building America: Develops New Innovations and Best Practices

Builders Challenge: Recognizes Leading Builders Applying Proven Innovations and Best Practices

ENERGY STAR: Recognizes Builders Who Deliver Significantly Above Code Performance

IECC Code: Mandates technologies and practices proven reliable and cost-effective

U.S. Department of Energy Challenge Home
Thermal Loads Reduced as Homes Improve
Above Code Standards

- Home Energy Rating
- ENERGY STAR for New Homes
- Next Step Home
- LEED
- National Green Building Standard
- Passivhaus
ENERGY STAR: Added Value Based on Building Science

Core Efficiency Measures
Guarantees that efficiency measures are included in every qualified home.

System Inspection Checklists
Sets standards for details that have a critical impact on efficiency, comfort, quality, and durability.
RESNET HERS® INDEX Estimates for Zone 6 IECC

- 2006 IECC
- 2009 IECC
- 2012 IECC
- Typical ENERGY STAR Home/2015 IECC
- Builder’s Challenge
- Passive House
- Zero Energy Home
- Less Energy
- 11
The Montana State Codes as Amended

Chapters: 1-10, 15, & 44
## I-Codes Overlap and Interaction

<table>
<thead>
<tr>
<th>Topic</th>
<th>IECC</th>
<th>IRC</th>
<th>IMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>HVAC Sizing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulation Values</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Window/Skylight U-Factors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>House Tightening</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Duct Sealing and Tightening</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Lighting Efficiency</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Foam Thermal Properties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vapor Retarders</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crawlspace Ventilation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Energy Code Evolution

![Graph showing energy code evolution from 1975 to 2015 with key milestones such as Standard 90-75, MEC 1983/86, MEC 1992/93, MEC 1995, IECC 1998, IECC 2004/06, IECC 2009, and IECC 2012, indicating percentage savings at each step. The graph is sourced from BECP.](image-url)
## 2011 Montana Energy Code Compliance Study

<table>
<thead>
<tr>
<th>Method</th>
<th>Local Code Jurisdictions</th>
<th>Self-Certifying Areas</th>
<th>Combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNNL Checklist</td>
<td>79%</td>
<td>50%</td>
<td>61%</td>
</tr>
<tr>
<td>Significant Items</td>
<td>96%</td>
<td>72%</td>
<td>81%</td>
</tr>
<tr>
<td>Energy Consumption</td>
<td>83%</td>
<td>52%</td>
<td>64%</td>
</tr>
</tbody>
</table>
## 2011 Montana Energy Code Compliance Study

### Provisions with Poor Compliance

<table>
<thead>
<tr>
<th>Compliance Item</th>
<th>Qty Inspected</th>
<th>% Compliant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction documentation</td>
<td>66</td>
<td>20%</td>
</tr>
<tr>
<td>HVAC Loads Calculations</td>
<td>49</td>
<td>14%</td>
</tr>
<tr>
<td>Basement wall exterior insulation installed per manufacturer’s</td>
<td>17</td>
<td>24%</td>
</tr>
<tr>
<td>Crawl space continuous vapor retarder</td>
<td>58</td>
<td>53%</td>
</tr>
<tr>
<td>Duct insulation</td>
<td>10</td>
<td>60%</td>
</tr>
<tr>
<td>Insulation labeling</td>
<td>79</td>
<td>48%</td>
</tr>
<tr>
<td>Attic hatch insulation and gasket</td>
<td>79</td>
<td>44%</td>
</tr>
<tr>
<td>Energy Certificate</td>
<td>82</td>
<td>63%</td>
</tr>
</tbody>
</table>
House as a System

Viewing a house as a system means understanding and managing the way that three things move on or through homes.

- Moisture (Water and Vapor)
- Air
- Heat
What Tighter Houses Mean

A. Reduced drying potentials
B. Increased importance of controlling moisture flow

Source: These principles are a variation on EEBA “Houses that Work” publications.
Top Building Science Principles

The Critical Nature of Drying Potential

- **Heating Climates** - to the exterior
- **Cooling Climates** - to the interior
- **Climates with both Heating and Cooling** – both directions

Source: NCAT
Top Building Science Principles

The Importance of Continuity

- Air barriers
- Thermal barriers

All must be continuous to be truly effective.
Top Building Science Principles

The Big Three Agents of Destruction

• Water
• Heat
• Ultraviolet Radiation

Of the three, which is the most important by far?

Source: Paul Tschida, MT DEQ
Top Building Science Principles

**Moisture Control Priorities:**

- Liquid or bulk water
- Air-transported water vapor
- Water vapor diffusion

Source: EEBA Builders Guide Series by Joe Lisibueck, Building Science Corporation

Source: stock.xcchng
Top Building Science Principles

“People do what you inspect, not what you expect.”
Lou Gerstner, former CEO of RJR Nabisco and IBM

Corollary: “If you measure it, it gets better.”
Saturn Resource Management

Featured Products

Residential Energy
$59.00

Energy Auditor
$595.00

Curriculum License
$4,700.00

Energy Auditor Field Guide
$39.00

http://www.srmi.biz/
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For more excellent publications and building science information from Building Science Corporation refer to their web site: [www.buildingscience.com](http://www.buildingscience.com)
USDOE Building America

BUILDING AMERICA BEST PRACTICES SERIES

BUILDERS CHALLENGE GUIDE TO
40% Whole-House Energy Savings in the Cold and Very Cold Climates

PREPARED BY
Pacific Northwest National Laboratory
& Oak Ridge National Laboratory
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